RESEARCH PROPOSAL

"A STUDY ON OPTIMIZING INVENTORY CONTROL FOR DETERIORATING ITEMS OF MARATHWADA REGION"

A Synopsis submitted to

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED (M.S.), INDIA

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By

Research Scholar

Mr. RAJEGORE AVINASH DILIP

M.Sc. (Statistics)

Mobile No: 7350091930

Email ID : avinashrajegore1@gmail.com

Under the Guidance of

Dr. INGALE KISHOR YADURAJRAO

Assistant Professor & Head,

Department of Statistics,

Netaji Subhash chandra Bose College, Nanded-431601

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Index

Sr.no.	Title
1	Introduction
2	Review of Literature
3	Scope and Limitations
4	Research Hypothesis
5	Research Objective
6	Research Methodology
7	Research Application
8	References

“A STUDY ON OPTIMIZING INVENTORY CONTROL FOR DETERIORATING ITEMS OF MARATHWADA REGION”

Introduction

The efficiency of inventory management, a crucial part of supply chain management, may have a big impact on the competitiveness and profitability of a company. However, there are particular difficulties in maintaining an inventory of decaying goods. Deteriorating things, such as food items, medications, and perishable commodities, have a short shelf life and can deteriorate or degrade over time. Ineffective management of these products can lead to waste, missed revenues and high inventory holding costs.

In order to implement effective inventory control systems for degrading products, variables including item degradation rates, lead time variability, and demand uncertainty must be carefully taken into account.

Effective inventory control enables businesses to minimize losses, reduce costs, and improve customer satisfaction. However, managing inventory becomes even more complex when dealing with deteriorating items, which are products that lose their value or become obsolete over time.

In this comprehensive review, we will provide an in-depth analysis of the importance of optimizing inventory control for deteriorating items, the challenges associated with managing such items, and the benefits of implementing effective inventory control strategies. We will also discuss the mathematical models used to optimize inventory control for deteriorating items and provide examples of real-world applications.

Deteriorating items are common in various industries, including food, pharmaceuticals, cosmetics, and electronics. These items have a limited shelf life, and their value decreases over time. If not managed properly, deteriorating items can result in significant losses for businesses.

Optimizing inventory control for deteriorating items is crucial for several reasons:

1. Reduced losses: Effective inventory control helps minimize losses due to deterioration, obsolescence, or expiration.

2. Improved customer satisfaction: By ensuring that products are available when customers need them, businesses can improve customer satisfaction and loyalty.

3. Increased efficiency: Optimized inventory control enables businesses to streamline their operations, reducing waste and improving productivity.

4. Better decision-making: Accurate inventory data enables businesses to make informed decisions about production, pricing, and inventory levels.

Challenges Associated with Managing Deteriorating Items

Managing deteriorating items poses several challenges, including:

1. Uncertainty about demand: Forecasting demand for deteriorating items can be difficult due to factors like seasonality, trends, and weather.

2. Limited shelf life: Deteriorating items have a limited shelf life, which can result in losses if not managed properly.

3. High holding costs: Holding deteriorating items in inventory can result in high costs due to storage, maintenance, and insurance.

4. Difficulty in estimating deterioration rates: Estimating the rate at which items deteriorate can be challenging, making it difficult to develop effective inventory control strategies.

Benefits of Implementing Effective Inventory Control Strategies

Implementing effective inventory control strategies for deteriorating items can result in numerous benefits, including:

1. Reduced inventory costs: Effective inventory control can help minimize inventory costs, including holding, ordering, and shortage costs.

2. Improved inventory turnover: Optimized inventory control can help improve inventory turnover, reducing the risk of obsolescence and deterioration.

3. Increased customer satisfaction: By ensuring that products are available when customers need them, businesses can improve customer satisfaction and loyalty.

4. Better decision-making: Accurate inventory data enables businesses to make informed decisions about production, pricing, and inventory levels.

Economic Order Quantity (EOQ) Model for Deteriorating Items

The EOQ model is a widely used inventory control model that determines the optimal order quantity for a product. When dealing with deteriorating items, the EOQ model needs to be modified to take into account the deterioration rate.

Modified EOQ Model for Deteriorating Items

The modified EOQ model for deteriorating items is given by the following equation:

$$Q^* = \sqrt{2DS/(H + \theta)}$$

Where:

Q^* = optimal order quantity

D = annual demand

S = ordering cost

H = holding cost

θ = deterioration rate

The modified EOQ model for deteriorating items takes into account the deterioration rate (θ) in addition to the holding cost (H). The optimal order quantity (Q*) is determined by balancing the holding cost and the ordering cost, while also considering the deterioration rate.

The goal of this research is to create an inventory control system that is optimised for decaying products while accounting for their particular difficulties and traits. To ascertain the ideal inventory levels, order amounts, and replenishment procedures for degrading commodities the suggested system will make use of sophisticated mathematical modelling and optimisation approaches.

2. Literature Review

Ghare and Schrader were the first in inventory control to create an inventory model specifically for decaying items. They developed a model for Deteriorating products for which shortages were not allowed. A lot sizing problem with time-dependent demand under inflationary conditions was established by Hariga and Ben-day. A finite time horizon EOQ model with backordering was developed by Ray and Chaudhari that takes into consideration the time value of money and the effect of inflation in addition to the fluctuating demand rate. Chen examined a scenario where shortages are completely backordered and demand is time-proportionate. He looked into how time and inflation affected everything. Green products and industrial process design have a substantial impact on the environment and resource reuse, according to Chung. These factors, along with global warming, environmental consciousness, and shorter product life cycles, have drawn more attention to ecological preservation and resource utilisation.

A number of scholars, including Shah and Jaiswal, Aggarwal, Dave and Patel, Sachan, and Goyal and Giri, concentrate on deterioration cases that are connected to the pace of deterioration in inventory. Nonetheless, a lot of them have only partially addressed some of the points raised by scholars. Among them are the three dynamic programming models for three frequently used lot size models with non-stationary demand over a finite planning horizon that Haringey has created. Bose et al. have also introduced a study on a finite horizon EOQ model with equal parts, constant deterioration rate, linear time independent rate, permitting entire backordered shortages, and adding the time value of money and inflation effect.

Additionally, Chung and Lin have created an inventory model for deterioration items that is comparable to Bose et ale's model, accounting for time value of money over a fixed planning horizon divided into equal parts, both with and without backlogging, and they have demonstrated that the total variable cost is convex. Similar to this, Moon and Lee examined the effects of time value of money and inflation across a finite horizon EOQ model, but for a random product life cycle. Wee and Law have also looked into a finite horizon inventory

model for an item that deteriorates with time in various situations where the demand is a diminishing function of the item price. While prior research has addressed inventory issues in inflationary environments, none of the aforementioned studies have examined scenarios in which production rates fluctuate over time and defective production amounts may exist. A continuous deterioration rate EOQ model was proposed by Balkhi and Benkherouf, however, shortages are permitted and fully backordered, and production and demand rates are arbitrary functions of time.

3. Scope and Limitations

Scope:

1. Product scope: Optimizing inventory control for deteriorating items applies to products with a limited shelf life, such as perishable goods, pharmaceuticals, and cosmetics.

2. Industry scope: This approach is relevant to various industries, including food, pharmaceuticals, cosmetics, and electronics.

3. Business function scope: Optimizing inventory control for deteriorating items involves managing inventory levels, reducing waste, and improving customer satisfaction.

4. Methodology scope: This approach involves using mathematical models, such as the Economic Order Quantity (EOQ) model, to determine the optimal inventory levels and reorder points.

Limitations:

1. Assumptions about demand and lead time: Optimizing inventory control for deteriorating items assumes that demand and lead time are known and constant, which may not always be the case.

2. Limited consideration of external factors: This approach may not fully consider external factors such as weather, seasonality, and economic trends.

3. Assumptions about deterioration rates: Optimizing inventory control for deteriorating items assumes that deterioration rates are known and constant, which may not always be the case.

4. Limited consideration of multiple products and inventory levels: This approach may not fully consider the complexities of managing multiple products and inventory levels.

5. Requires accurate and timely data: Optimizing inventory control for deteriorating items requires accurate and timely data on demand, lead time, and deterioration rates, which may be difficult to obtain.

4. Research Hypothesis

1. Optimised inventory control policies can lower inventory holding costs for degrading products: Organisations can lower the expenses related to keeping inventory of deteriorating things by creating and putting into place optimised inventory management rules.

2. Decisions about inventory management for deteriorating things are significantly influenced by degradation rates: When creating inventory control rules, it is important to consider how quickly degrading items deteriorate or spoil.

3. Advanced inventory control models can be used to mitigate demand uncertainty and lead time variability: Organisations can lessen the influence of these factors on inventory control decisions by utilising advanced inventory control models that take these factors into account.

5. Research Objectives

Some of the objectives of the research study are

1. To create and implement an effective inventory control system: one can precisely monitor and regulate the stock levels of beautifying items, minimising overstocking and stock outs.

2. To increase inventory visibility and accuracy: By putting in place a dependable and easy-to-use inventory control system, real-time tracking and level monitoring are made possible.

3. To streamline the purchasing and inventory replenishment procedures: By creating an automated system that can produce buy orders, estimate ideal order quantities, and forecast demand.

4. To lower inventory costs and boost profitability: By cutting waste, increasing inventory turnover, and minimising stockholding expenses.

5. To increase client loyalty and satisfaction: By minimising stock outs and backorders and guaranteeing prompt and precise delivery of decorating supplies.

6. To increase the effectiveness and cooperation of the supply chain: By connecting the inventory control system with suppliers and other stakeholders, real-time communication and cooperation are made possible.

6. Research methodology

1. Literature review: Examine previous studies on inventory management for beautifying items and inventory control systems.
2. Case studies: To determine existing inventory management opportunities and difficulties, do in-depth case studies of sellers of decorating items.
3. Surveys and interviews: To learn more about the difficulties and existing inventory management procedures, conduct surveys and interviews with suppliers and merchants of decorating items.
4. System development and testing: Create, implement, and evaluate a system for inventory control of decoration supplies.

5. Using the Economic Order Quantity (EOQ) Model: The ideal order quantity that minimises overall inventory costs is determined.
6. Weibull Distribution Model: This model uses a Weibull distribution to simulate how things deteriorate over time.
7. Exponential Distribution Model: This model uses an exponential distribution to simulate how things deteriorate over time.
8. Linear Programming (LP): This method uses linear programming techniques to optimise inventory control choices.

7. Research Applications

Some of application of the study is stated below:

1. Food Industry: Managing inventory of perishable food items, such as fruits and vegetables.
2. Pharmaceutical Industry: Managing inventory of medicines with limited shelf life.
3. Cosmetics Industry: Managing inventory of cosmetics with limited shelf life.
4. Electronics Industry: Managing inventory of electronic components with limited shelf life.

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Research Student
Mr. Rajegore Avinash Dilip

Research Supervisor
Dr. Ingale Kishor Yadurajrao